

# Comparing the Digital Footprint of Pulmonary and Critical Care Conferences on Twitter

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**Background:** Pulmonary and critical care societies, including the American Thoracic Society, the American College of Chest Physicians, and the Society of Critical Care Medicine have large memberships that gather at academic conference events, attracting thousands of attendees.

**Objective:** With the growth of social media use among pulmonary and critical care clinicians, our goal was to examine the Twitter presence and digital footprint of these three major medical society conferences.

**Methods:** We used Symplur Signals (Symplur, LLC) to track the tweets and most active participants of the 2017–2019 annual conferences of American Thoracic Society, American College of Chest Physicians, and the Society of Critical Care Medicine. Attendance records of participants were obtained from each society.

**Results:** During the study period, there was growth in the number of tweets, participants, and impressions for all three society conferences. Across all conferences, the amount of original content generated was less than the retweets, which comprised 50–72% of all tweets. Individuals physically attending each conference were more likely to post original content than those not in attendance (53–68% vs. 32–47%). For each

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society and at each meeting, clinicians made up the largest group of participants (44–60%), and most (59–82%) were physicians. A small cohort of participants was responsible for a large share of the tweets, with more than half of the participants at each conference for each society tweeting only once and only between 5–8% of participants tweeting more than 10 times. Seventy-eight individuals tweeted more than 100 times at one or more of the conferences. There was significant overlap in this group, with 32 of these individual participants tweeting more than 100 times at two or more of these conferences.

**Conclusion:** Growth in conference digital footprints is largely due to increased activity by a small group of prolific participants that attend conferences by multiple academic societies. Original content makes up the smallest proportion of posts, suggesting that amplification of content is more prevalent than posting of original content. In a postpandemic environment, engagement of users producing original content may be even more important for medical societies.

**Keywords:**

social media; healthcare communication; digital health; conference social media; patient centered care

Even prior to the pandemic and the accompanying shift to online platforms, medical conferences had embraced social media for content dissemination (1–5). Pulmonary and critical care societies such as the American Thoracic Society (ATS), the American College of Chest Physicians (CHEST), and the Society of Critical Care Medicine (SCCM) encouraged social media activities at their annual meetings to build community, grow the societies' membership, and market their content (2, 3). Prepandemic, these large academic conferences would attract thousands of

in-person attendees eager to learn the latest in pulmonary and critical care, present their own research findings, and to network.

We had described the growth of the SCCM Critical Care Congress (CCC) and the changing digital footprint over time before the pandemic (3). We found a significant growth in live tweeting, largely driven by a group of highly engaged users. With this study, we sought to 1) determine the influence of in-person attendance on tweeting behavior; 2) further characterize a group of high-frequency tweeters who tweeted across three major pulmonary

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and critical care medical conferences in North America; and 3) determine the effect of this group of individuals on the overall digital footprint for that conference. A better understanding of who is influencing the growth of social engagement across national societies is important to understanding this new digital landscape and for organizations to better engage these participants. As medical conferences change in a postpandemic world, this will provide an important baseline for comparison.

An abstract for this work was presented at the CHEST 2020 annual meeting (6).

## METHODS

We used Symplur Signals (Symplur, LLC), an online analytic tool, to define a digital footprint by tracking the tweets and most active participants of the 2017–2019 annual conferences and/or congresses of ATS, CHEST, and SCCM using a previously described methodology (7). Official conference hashtags promoted by the society were used (#ATS2017, #ATS2018, #ATS2019, #CHEST2017, #CHEST2018, #CHEST2019, #CCC46, #CCC47, and #CCC48). Attendance records of specific participants were obtained from each society and matched to Twitter usernames.

The number of tweets, participants, and impressions (i.e., potential views) for each year's Congress hashtag were collected for a 7-day period for each conference. Characteristics of the tweets were collected, including the number of tweets with mentions of other users, number of tweets that included visual media (pictures, GIF, or video), number of tweets that included links, number of tweets with replies, and number of tweets that are retweets. Number of tweets included original tweets and retweets. The characteristics of the

participants were also collected, including stakeholder type and average and median number of tweets per participant. Stakeholder types were classified by Symplur Signals, which uses a process that includes algorithms, machine learning models, and manual human evaluation to categorize 19 different categories of stakeholders (8). We further aggregated the Symplur defined categories into five groups of stakeholder types (clinicians, physicians, individual nonhealth, healthcare organizations, and industry). Clinicians included physician and nonphysician healthcare providers.

The participants who tweeted most frequently at each conference were identified, and data were collected on the top 100 participants at each conference. The twitter usernames of these top 100 participants were matched to real names given in Twitter user profiles. Then, conference attendance data for those users were obtained from each society, and data were compared between those in attendance and those tweeting remotely. A subset of high-frequency participants was also identified that tweeted more than 100 times at a medical society conference. Characteristics of these participants were compared, including type of stakeholder, number of conference tweets, and tweet characteristics. Data regarding specific names has been kept confidential.

Descriptive and comparative statistics were performed. Data were analyzed using JMP statistical software (version 15.2.1; SAS Institute, Inc.). Data are reported as frequencies (percentage), as mean  $\pm$  standard deviation, or as median with 25–75% interquartile range, depending on the type and distribution of the variables. A Shapiro-Wilk test was used to assess normality. Correlation coefficients, chi-square tests, Student's *t* tests, and Mann-Whitney *U* tests were used to

compare groups, as appropriate. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated where appropriate. Two-sided *P* values are reported, and a value less than 0.05 was considered statistically significant. This study was reviewed by the Connecticut Children's Institutional Review Board and considered exempt.

## RESULTS

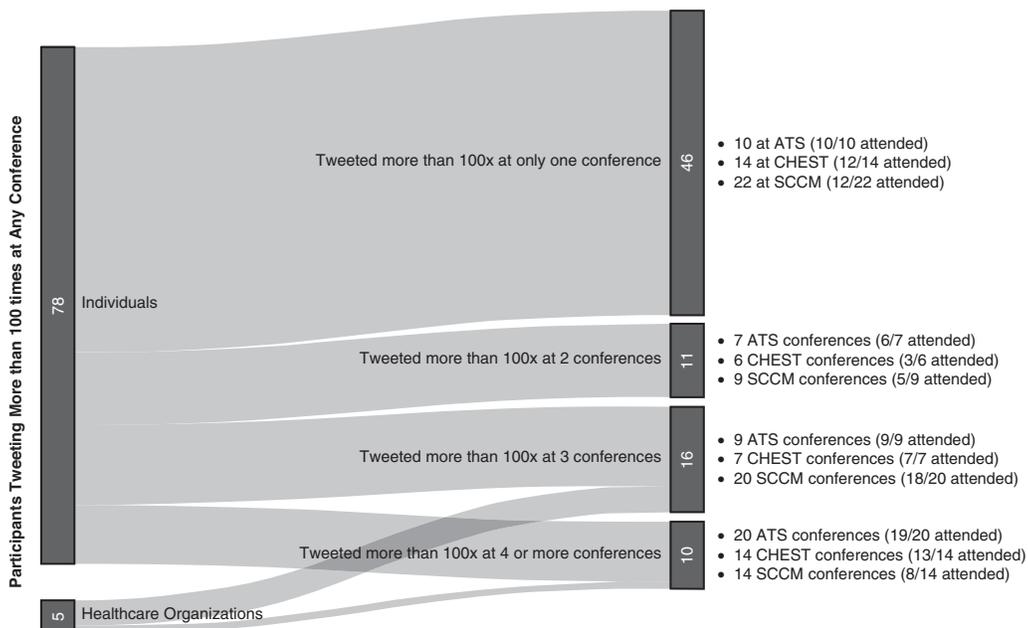
From 2017 to 2019, there was growth in the number of tweets, participants, and impressions for all three society conferences (Table 1). The types of stakeholders and the tweet characteristics were similar for each society and at each meeting. Clinicians made up the largest group of participants (44–60%), and most of them (59–82%) were physicians. Healthcare organizations made up between 9 and 18% of participants. ATS had significantly more healthcare organization participants than SCCM and CHEST (median 15% vs. 11% and 9%; *P* = 0.002 and *P* = 0.03, respectively) and the largest industry presence (median 3% vs. 0.3% and 1%; *P* = 0.01 and *P* = 0.006, respectively). At all conferences, the amount of original content generated was less than the retweets (50–72% of all tweets at each conference). A small cohort of prolific participants was responsible for a large share of the tweets, with more than half of the participants at each conference for each society tweeting only once. Only 5–8% of conference participants tweeted more than 10 times. Eighty-three unique participants tweeted more than 100 times at one or more of the conferences; 78 of these were individuals (Figure 1). This cohort of participants was responsible for a sizable percentage of the total conference tweets (range 16–59%) (Table 1, Figure 2). There was significant overlap in this group, with

32 of these individuals tweeting more than 100 times at two or more of these conferences (28 of 32 were physicians). We found that in this cohort, as the number of tweets per user rose, the percentage of retweets also rose ( $R^2 = 0.06$ ; *P* = 0.003). Participants who tweeted more than 100 times at more than two conferences were less likely to be in attendance than those who tweeted that frequently at two or less conferences (OR, 0.32; 95% CI, 0.14–0.75; *P* = 0.008). Individuals who tweeted more than 100 times at SCCM were less likely to be in attendance at the conference than those tweeting more than 100 times at CHEST or ATS conferences (OR, 0.20; 95% CI, 0.08–0.48; *P* = 0.0003).

When examining the cohort of top 100 tweeters at each of the conferences (Table 2), we found that physicians who were attending the conference were the largest stakeholder group. Although there was no difference in the number of tweets generated by participants in attendance and those not in attendance, individuals attending were more likely to post original content than those not attending the conference (53–68% vs. 32–47%).

## DISCUSSION

We found that a cohort of highly engaged participants was responsible for the bulk of the content at three prominent pulmonary and critical care society conferences in North America, growing the digital footprint steadily over the years. The growth of reach via social media is well documented in medical society meetings (2, 3, 5, 9–11); however, to our knowledge, this study is the first to report a connection between content creators and attendance in multiple events. The findings provide an important baseline snapshot of how people



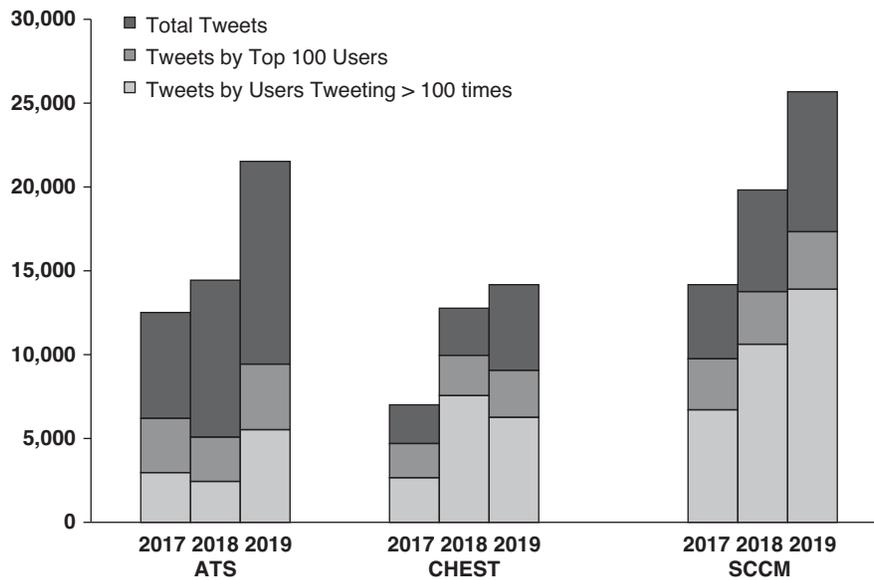
**Figure 1.** High-frequency tweeters. Attendance data only includes individuals. ATS = American Thoracic Society; CHEST = American College of Chest Physicians; SCCM = Society of Critical Care Medicine.

interacted with conferences on social media before the pandemic and point at possible strategies pulmonary and critical care societies might employ to increase their digital presence. However, these findings also highlight the limitations of the metrics used to assess social media growth and suggest that metrics assessing connections may be better suited to assess the spread and reach of a medical society's message.

It may be surprising that a relatively small cohort is responsible for so much of the digital footprint of these medical society conferences. Despite years of outreach, the relative percentages of those tweeting once and those tweeting more than 10 times is unchanged. A cohort of high-frequency tweeters tweeted more than 100 times at least once, and 10 of these individuals tweeted more than 100 times at four or more of the nine different medical conferences held by the three medical societies over this 3-year period. Two of these individuals tweeted at seven of the nine

conferences. Seven of the eight authors of this paper tweeted 100 times at least once at a conference (median number of conferences, 4.5; range, 3–7).

The individual motivation behind this frequent tweeting behavior has not been studied in medicine, although others have attempted to ascertain why people use different social media platforms (12, 13). As a whole, a large majority of the tweets are posted to Twitter by a small group of users (14). In our review, many of the high-frequency tweeters have leadership positions in one or more of the organizations whose conferences they are tweeting for. But some had no formal leadership roles in the organization at the time. Most may tweet for altruistic reasons to disseminate reliable and cutting-edge science to an audience that is passionate about similar areas of interest. High-frequency tweeting at a conference can also identify engaged future leaders of that organization, and participants may be attempting to demonstrate their engagement and



**Figure 2.** Conference tweets by participants. ATS = American Thoracic Society; CHEST = American College of Chest Physicians; SCCM = Society of Critical Care Medicine.

establish longer term partnerships with other key opinion leaders. However, it is also possible that secondary gains are a motivating factor. Sometimes, having the highest number of tweets is a point of pride and participants may view this as a contest or game. Some may use their social media coverage of a conference to accrue followers or social media clout.

We found an increased frequency of retweets in social media users that did not attend conferences in person. It is no surprise that conference attendees share more new information as they receive it in real time and have the ability to share screenshots and first impressions. Beyond that, in each of the conferences, there were participants who retweeted hundreds or thousands of times without actually attending the conference, which may compromise the overall quality of the tweets. Additionally, there is the possibility that individuals or organizations attempting to manipulate the discussion may introduce bias. Nonetheless, reliable amplifications can also increase the digital reach of an event across the globe,

spanning different time zones and potentially penetrating local and geographically remote networks not accessible to attendees.

Although the total number of participants tweeting during each of the conferences increased, the median number of tweets remained low. There could be several reasons for this, including a lack of knowledge about how to tweet efficiently during conferences, uncertainty over what type of content to post, and feeling overwhelmed by the large amount of fast-moving content while tweeting at a live presentation. Although live tweeting has been evaluated, the attitudes, barriers, and facilitators for live tweeting have not been well studied. Major academic societies and journals have social media committees and social media editorial boards to help engage their audience members and disseminate content. Although tweets and retweets suggest some engagement with content at conferences, their true impact on engagement, learning, and change in practice are more difficult to measure and will need further study.

**Table 1.** Digital footprints of the critical care societies collaborative meetings

	ATS			CHEST			SCCM		
	2017	2018	2019	2017	2018	2019	2017	2018	2019
Tweets	12,514	15,441	21,526	7,009	12,770	14,587	14,169	19,821	25,678
Percent retweets	60%	63%	58%	51%	67%	50%	60%	72%	71%
Median tweets per participant	1 (1-2)	1 (1-2)	1 (1-3)	1 (1-2)	1 (1-3)	1 (1-2)	1 (1-2)	1 (1-3)	1 (1-3)
Percent participants with 1 tweet	61%	65%	61%	67%	57%	64%	66%	60%	59%
Percent participants with >10 tweets	6%	6%	8%	5%	7%	7%	7%	8%	8%
Number of participants with >100 tweets	0.4%	0.3%	0.6%	0.8%	1.0%	0.9%	1.0%	1.0%	1.0%
Number of tweets by participants with >100 tweets (% of conference tweets)	2,968 (24%)	2,438 (16%)	5,525 (26%)	2,662 (38%)	7,588 (59%)	6,257 (43%)	6,708 (47%)	10,622 (53%)	13,895 (54%)
Percent retweets by participants with >100 tweets	63% (21-78%)	51% (11-64%)	52% (39-71%)	24% (16-59%)	49% (35-64%)	32% (13-61%)	52% (33-78%)	70% (48-88%)	71% (56-91%)
Participants	3,049	4,389	4,616	1,538	1,466	2,418	2,229	2,580	3,221
Stakeholder type									
Clinician	51%	44%	51%	46%	54%	54%	60%	55%	49%
Physician	37%	36%	42%	27%	37%	37%	47%	43%	37%
Individual nonhealth	8.9%	5.3%	4.4%	8%	5%	4%	10%	8%	5%
Healthcare organization	17.6%	15.4%	13.4%	11%	9%	9%	11%	11%	10%
Industry	2.9%	3.0%	2.0%	1%	2%	1%	0.3%	0.4%	0.2%
Impressions (millions)	37.7	43.4	73.6	31.6	47.1	48.7	29.1	76.1	79.9

*Definition of abbreviations:* ATS=American Thoracic Society; CHEST=American College of Chest Physicians; SCCM= Society of Critical Care Medicine. Data are presented as frequency (%), median (25-75% interquartile range), or mean±standard deviation.

**Table 2.** Characteristics of top 100 tweeters at each conference

	ATS			CHEST			SCCM		
	2017	2018	2019	2017	2018	2019	2017	2018	2019
Total number of tweets (% of conference tweets) by top 100 tweeters	6,206 (50%)	6,081 (39%)	9,435 (44%)	4,696 (67%)	9,960 (78%)	9,482 (65%)	9,752 (69%)	13,761 (69%)	17,329 (67%)
Number of tweets per conference by top 100 tweeters	33 (24–61)	35 (27–72)	58 (41–111)	19 (12–34)	25 (16–50)	41 (28–82)	39 (23–87)	50 (31–102)	66 (41–137)
Percent individuals	61%	67%	72%	74%	82%	85%	79%	85%	81%
Percent individuals attended conference	77% (n = 47/61)	84% (n = 56/67)	89% (n = 64/72)	50% (n = 37/74)	63% (n = 52/82)	68% (n = 58/85)	51% (n = 40/79)	60% (n = 51/85)	69% (n = 56/81)
Percent retweets by individuals attending conference	47% (17–68%)	58% (31–58%)	42% (31–63%)	30% (11–46%)	41% (23–63%)	32% (12–53%)	40% (26–63%)	58% (24–75%)	41% (25–64)
Percent retweets by individuals not attending conference	79% (39–100%)	54% (35–100%)	46% (18–97%)	68% (24–95%)	63% (30–100%)	83% (10–96%)	81% (32–100%)	80% (48–100%)	90% (64–100%)
Number of tweets of individuals attending conference	38 (25–89)	39 (27–76)	61 (39–123)	30 (13–103)	31 (17–105)	59 (28–141)	42 (27–92)	57 (34–168)	59 (39–212)
Number of tweets of individuals not attending conference	21 (20–37)	30 (26–80)	47 (34–101)	15 (12–30)	19 (14–36)	36 (26–64)	38 (24–68)	47 (28–88)	75 (45–122)

*Definition of abbreviations:* ATS = American Thoracic Society; CHEST = American College of Chest Physicians; SCCM = Society of Critical Care Medicine. Data are presented as frequency (%) or median (25–75% interquartile range).

Large medical conferences have existed as a means to share and learn the latest scientific and clinical information. It is unclear how people will attend, interact, and engage at future postpandemic medical conferences. Prepandemic, some healthcare professionals were unable to attend conferences because of time, travel, and financial limitations. In 2020 and 2021, many conferences have been shifted to an entirely digital platform. Even after travel restrictions are lifted and as people become more comfortable attending conferences in person, it is likely that medical societies will be offering increasing amounts of digital or hybrid components. The success of a digital network involves the creation of new content and not just the amplification of content through retweeting. So how can medical societies ensure quality original content on social media? Engaging a core group of active tweeters may be an answer. But this may be more difficult when these participants are not physically in attendance or when conferences are digital. We propose that highly engaged social media users have an active role in conference activities and be provided with guidance, resources, and a framework to engage with conferences, be it in person or digitally. The goal for an organization would be to ensure dissemination of accurate content while increasing the digital reach of conferences, which are likely to have a hybrid method of delivery (in person and digital) in the foreseeable future.

This study is limited by several factors. Data were collected using Symplur

Signals, from which stakeholder groups were identified and categorized. These categorizations may not always be accurate, and there may be overlap in some of these categories. The data received from Twitter may also be incomplete, and users with private accounts will not be captured. Additionally, because of the large volume of data included, hand-checking this data is not feasible.

## CONCLUSIONS

The digital footprints of pulmonary and critical care medical conferences continue to increase on Twitter. Although over half of all attendees tweet during a conference, the majority of tweets are generated by a small group of highly engaged social media users that attend the conferences of multiple academic societies. Although retweeting content is more frequent, original content posts are more likely to be generated by individuals attending conferences in person. The evolution of medical conferences and attendee engagement in the postpandemic era remains to be seen.

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